

What is claimed is:

1. A correlated filter device, comprising:  
a compensation stack including a plurality of layers, wherein an optical thickness of at least some of said layers of said compensation stack do not equal an integer multiple of one-quarter of a wavelength of light having a first wavelength corresponding to a first  
5 passband of said filter device having a first center wavelength.
2. The device of Claim 1, wherein said filter device further comprises a second passband having a second center wavelength and a third passband having a third center wavelength, wherein said first center wavelength is separated from said second center wavelength by a first amount, and wherein said second center wavelength is separated from said third center wavelength by a second amount that is not equal to said first amount.
3. The device of Claim 1, wherein said optical thickness of a layer comprises a distance equal to a thickness of said layer multiplied by an index of refraction of said layer.
4. The device of Claim 1, wherein said first wavelength is a wavelength of light in a vacuum.
5. The device of claim 1, further comprising:  
an optical cavity.

6. The device of Claim 5, further comprising a reflective stack including a plurality of layers, wherein a said compensation stack is associated with a first reflective surface of said optical cavity, and wherein said compensation stack comprises a second reflective surface of said optical cavity.

7. The device of Claim 5, wherein said optical cavity has an optical thickness greater than ten of said first wavelengths.

8. The device of Claim 5, wherein said optical cavity comprises an etalon.

9. The device of Claim 8, wherein said etalon comprises at least one of a Silicon etalon and a Germanium etalon.

10. The device of Claim 8, wherein said etalon comprises a Silicon etalon and has a thickness of about  $386.5\mu\text{m}$ .

11. The device of Claim 1, further comprising:  
a plurality of optical cavities.

12. The device of Claim 11, wherein at least some of said optical cavities are formed as layers within said compensation stack.

13. The device of Claim 11, wherein said plurality of optical cavities comprise layers within a filter having an optical thickness at least as great as one-half of said first center wavelength.

14. The device of Claim 1, wherein said compensation stack comprises high index of refraction layers formed from Germanium and low index of refraction layers formed from Silicon Monoxide.

15. The device of Claim 1, further comprising:  
a bandpass filter.

16. A system for sensing atmospheric trace gases, comprising:  
at least a first optical cavity;  
a first reflective stack forming a first reflective surface of said optical cavity, said  
first reflective stack including a plurality of thin film layers, wherein at least one of said  
5 thin film layers has an optical thickness that is not equal to one quarter of a wavelength of  
light at a first passband of said system; and  
a second reflective stack forming a second reflective surface of said optical  
cavity.

17. The system of Claim 16, wherein said at least a first optical cavity  
comprises an etalon having an optical thickness greater than about ten times said  
wavelength of light at said first passband of said system.

18. The system of Claim 17, wherein said etalon comprises at least one of a  
Silicon and a Germanium etalon.

19. The system of Claim 16, wherein said first reflective stack comprises a  
compensation stack, wherein passbands of said system are not regularly spaced, and  
wherein said second reflective stack comprises a bandpass filter.

20. The system of Claim 19, wherein said system includes at least six  
passbands, and wherein each of said six passbands is centered at an absorption line of an  
atmospheric gas.

21. The system of Claim 20, wherein said atmospheric gas comprises one of Carbon Monoxide and Carbon Dioxide.

22. The system of Claim 16, wherein said first reflective stack comprises Germanium high index of refraction layers and Silicon Monoxide low index of refraction layers.

23. The system of Claim 19, further comprising a detector, wherein light having a wavelength within said first passband, a second passband, and a third passband of said system is received at said detector, and wherein said first, second, and third passbands are separated from one another by different amounts.

24. A system for sensing atmospheric trace gases, comprising:  
a correlation filter including:  
a plurality of thin film layers, wherein said thin film layers include a plurality of  
high index of refraction layers and a plurality of low index of refraction layers, wherein at  
5 least some of said thin film layers has an optical thickness that is not equal to a  
quarterwave of light having a first wavelength corresponding to a center wavelength of a  
first passband of said correlation filter; and  
a plurality of optical cavities.

25. The system of Claim 24, wherein said plurality of optical cavities  
comprise thin film layers having an optical thickness of at least one-half a wavelength of  
said first wavelength.

26. The system of Claim 24, wherein passbands of said system are not  
regularly spaced.

27. The system of Claim 24, further comprising:  
a substrate, wherein said compensation stack is interconnected to a first surface of  
said substrate.

28. The system of Claim 27, further comprising:

a bandpass filter stack, including a plurality of high index of refraction thin film layers and a plurality of low index of refraction thin film layers interconnected to a second surface of said substrate.

29. The system of Claim 24, wherein said system includes at least six passbands, and wherein each of said six passbands is centered at an absorption line of an atmospheric gas.

30. The system of Claim 29, wherein said atmospheric gas comprises one of Carbon Monoxide and Carbon Dioxide.

31. The system of Claim 24, wherein said high index of refraction layers comprise Germanium and said low index of refraction layers comprise Silicon Monoxide.

32. The system of Claim 24, further comprising a detector, wherein light having a wavelength within said first passband, a second passband, and a third passband of said system is received at said detector, and wherein said first, second, and third passbands are separated from one another by different amounts.

33. A method for selectively filtering light, comprising:  
identifying a spectral response of interest, wherein said spectral response of  
interest comprises a number of non-linearly spaced spectral lines;  
selecting a desired number of said spectral lines for observation; and  
5 forming a correlation filter comprising a compensation stack having a plurality of  
layers, at least some of which have an optical thickness that is not equal to one-quarter of  
a wavelength of light corresponding to one of said spectral lines, wherein said filter  
substantially blocks the passage of light at wavelengths not corresponding to said selected  
spectral lines, and wherein said filter substantially passes light at wavelengths  
10 corresponding to said selected spectral lines.

34. The method of Claim 33, further comprising:  
receiving light;  
passing said received light through said correlation filter; and  
outputting from said filter light at wavelengths corresponding to said selected  
5 spectral lines.

35. The method of Claim 34, further comprising:  
simultaneously detecting an intensity of light at each of said wavelengths  
corresponding to said selected spectral lines.



36. The method of Claim 34, wherein said step of outputting light at wavelengths corresponding to said selected spectral lines comprises outputting light at a center wavelength of each of said selected spectral lines.

37. The method of Claim 34, wherein said step of outputting light at wavelengths corresponding to said selected spectral lines comprises outputting light at wavelengths corresponding to a selected position along a line wing of said selected spectral lines, wherein information regarding an altitude distribution of an atmospheric  
5 gas is obtained.

38. The method of Claim 33, wherein an optical path of light having a first wavelength through said filter is a first distance, and wherein an optical path of light having a second wavelength through said filter is a second distance.

39. The method of Claim 33, wherein a phase shift of light by said filter is non-linear, wherein a spacing between said first wavelength of said first passband, a second wavelength of a second passband, and a third wavelength of a third passband of said filter are separated from one another by amounts that are at non-integral multiples of  
5 an amount equal to one-quarter of said first wavelength.

40. The method of Claim 33, wherein said selected number of spectral lines for observation is at least 6.

41. The method of Claim 33, wherein said selected number of spectral lines for observation is at least 8.

42. The method of claim 34, further comprising, passing said light through a bandpass filter having a passband that includes wavelengths corresponding to said selected number of absorption lines.

43. A system for measuring atmospheric trace gas, comprising:  
means for gathering light from within a first field of view;  
means for filtering said gathered light having passbands at wavelengths  
corresponding to wavelengths of lines of absorption of an atmospheric gas; and  
5 means for measuring an intensity of said light within said passbands of said  
means for filtering.

44. The system of Claim 43, further comprising:  
means for calculating a concentration of an atmospheric trace gas from an output  
of said means for measuring an intensity.